Brain Injury, 2010, 1–7, Early Online

informa
healthcare

Association between combat stress and post-concussive symptom reporting in OEF/OIF service members with mild traumatic brain injuries

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(Received 14 May 2010; revised 27 June 2010; accepted 15 September 2010)

Abstract

Objective: The relationship between combat stress and post-concussive symptoms in service members with mild traumatic brain injuries (mTBI) is poorly understood. It was hypothesized that the co-occurrence of combat stress would have a significant effect on the severity of post-concussive complaints, specifically on emotional and cognitive symptoms.

Methods: Four hundred and seventy-two combat-deployed service members with mTBI completed self-report inventories of post-traumatic stress and post-concussive symptoms. Two groups were formed based on post-traumatic stress symptoms (High Combat Stress and Low Combat Stress).

Results: A 3–8-fold increase in post-concussive symptoms was observed when comparing the High and Low Combat Stress Groups. Elevations in post-concussive symptom reporting were not limited to emotional and/or cognitive symptoms, but rather were inclusive of all measured post-concussive symptoms.

Conclusions: The findings of the present study suggest that non-brain injury-related factors, such as high-levels of combat stress, may impact post-concussive symptom reporting in this population, further confounding the accuracy of the post-concussion syndrome (PCS) diagnosis. Considerable caution should be exercised in making the diagnosis of PCS in concussed service members with co-occurring combat-stress disorders.

Keywords: *Mild traumatic brain injury, blast injury, post-traumatic stress disorder, post-concussion syndrome*

Introduction

Considerable focus has been placed upon the identification and treatment of traumatic brain injury (TBI) in service members returning from combat-deployment [1]. Several recent studies provide incidence estimates for mild TBI (mTBI) among combat deployed troops serving in Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF). In a recent population cohort study, 4.9% of over 2500 Army infantry soldiers reported mild TBI with loss of consciousness and another 10.3% reported mild TBI with altered mental status [2]. Of injured service members who were evacuated from combat theatre and screened by the Defense and Veterans Brain Injury Center (DVBIC) at Walter Reed Army Medical Center between January 2003 and November 2008, 33% met criteria for mild TBI [3]. In one cross-sectional prevalence study of OEF/OIF service members, 12% of the sample of over 2200 respondents to a mail survey reported a history consistent with mild TBI during deployment [4]. These relatively high rates of mTBI in OIF/OEF reflect the frequent use of explosive munitions in the current conflicts. Additional reasons for the increased prevalence

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ISSN 0269–9052 print/ISSN 1362–301X online
DOI: 10.3109/02699052.2010.531692

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
15 SEP 2010		**00-00-2010 to 00-00-2010**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Association Between Combat Stress Snd Post-Concussive Symptom Reporting In OEF/OIF Service Members With Mild Traumatic Brain Injuries	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Brooke Army Medical Center,Department Of Orthopedics & Rehabilitation,FT. Sam Houston,TX,78234**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
Brain Injury, 2010, pgs 1-7,Informa Healthcare

14. ABSTRACT
The relationship between combat stress and post-concussive symptoms in service members with mild traumatic brain injuries (mTBI) is poorly understood. It is hypothesized that the co-occurence of combat stress would have significant effect on the severity of post-concussive complaints, specifically on emotional and cognitive symptoms.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**7**	

include reduced mortality from improvements in body armour, increased screening and diagnosis and greater knowledge and awareness of mild TBI arising from civilian sports-related injuries.

During the acute post-injury stage following a concussion, a cluster of non-specific symptoms, such as headache, cognitive complaints and sleep disturbance, are frequently reported. These symptoms can be broadly categorized into cognitive, affective, somatic and sensory symptom clusters [5], although it remains unclear whether sub-division of symptoms is clinically meaningful. Symptomatic recovery from mild TBI typically occurs within 3 months post injury in the vast majority of individuals [6]. Post-concussive syndrome (PCS) is a chronic condition often diagnosed when symptoms persist beyond 6 months [7], although the minimum symptom duration to make the diagnosis varies according to the diagnostic criteria [8]. Nevertheless, equivalent outcomes have resulted when comparing PCS based on *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV) criteria, requiring 3 months duration of symptoms, to diagnosis by *International Classification of Diseases* (ICD–10) in which there is no specific symptom duration [8].

It is also well-established that post-concussive symptoms are not specific to mild TBI, occurring in other conditions such as chronic pain [9], depression [10], as well as in non-clinical samples [11]; and are influenced by gender, pain, psychiatric history [12] and other psychosocial and environmental factors [13]. Of particular relevance to symptom report after injury in the deployed setting is the occurrence of post-traumatic stress. It is well-acknowledged that there is significant overlap between post-concussive and post-traumatic stress-related symptoms [2, 4], which may affect clinical outcomes and treatment. As stated recently by Powell [14], the importance of considering base rates of post-concussive symptoms in non-TBI populations is crucial to making the correct diagnostic attributions.

The current study examines the relationship between combat stress symptoms and post-concussive symptoms in a large sample of post-deployment service members who were diagnosed with mTBI. It was hypothesized that the co-occurrence of combat stress would have a significant effect on the severity of post-concussive complaints, specifically in the emotional and cognitive symptom clusters.

Methods

Participants

Subjects were active duty service members, including activated reservists and members of the National Guard, who were evaluated at a military medical treatment facility in San Antonio (Brooke Army Medical Center) following a combat deployment to Iraq or Afghanistan. The subjects were identified through multiple sources including inpatient care, post-deployment primary care clinics, specialty care clinics (e.g. Traumatic Brain Injury Service) and case management. All subjects had been screened for possible traumatic brain injury or blast exposure through a brief, three-item structured questionnaire. Service members identified as possibly sustaining a TBI through the three-item questionnaire were recruited for participation in a prospective IRB-approved study of service members with traumatic brain injuries, regardless of the presence or absence of clinical symptoms. Following informed consent, service members completed a structured clinical interview (i.e. Defense and Veterans Brain Injury Center Clinical Tracking Form) and self-report questionnaires as described below. Demographic and injury data, when available, were also collected. Subjects who did not sustain a TBI, as determined through the clinical interview, were not enrolled in the study.

The initial sample consisted of 565 service members diagnosed with mTBI during their combat deployment. Mild TBI, also referred to as concussion, was operationally defined as one or more of the following: loss of consciousness (<30 minutes); loss of memory for events immediately before (retrograde amnesia) or after the accident (post-traumatic amnesia (PTA) <24 hours); any alteration in mental state at the time of the injury (dazed, disoriented, confused); presence of focal neurological deficits; and a Glasgow Coma Scale (GCS) score$\geq$13, consistent with American Congress of Rehabilitation Medicine criteria [15]. Subjects with moderate or severe TBI (as defined by GCS$\leq$12, loss of consciousness (LOC) greater than 30 minutes and/or duration of PTA > 24 hours) or penetrating brain injuries were excluded from the current study ($n=87$). GCS scores, when present, were determined by a review of available medical records and represent the lowest post-resuscitation GCS score obtained by trauma personnel. Loss of consciousness and alteration of consciousness were determined by semi-structured clinical interview and based upon retrospective report. Since LOC and GCS scores could not be obtained for every subject, these variables were used solely in diagnostic determination and were not analysed separately. Six subjects were excluded who reported three or more combat deployments, due to the difficulty in obtaining a clear clinical history of concussion(s) and symptom onset following multiple deployments and potential blast exposures. Of the remaining 472 subjects, two groups were formed based upon the total score on

a measure of post-traumatic stress symptoms (see study design section below).

Measures

Symptoms of post-traumatic stress. The Posttraumatic Checklist-Civilian version (PCL-C [16]) is a self-rated interval-level rating scale used to screen for Post-traumatic Stress Disorder (PTSD). The PCL-C requires the identification of a specific traumatic event or occurrence from which symptoms are thought to be triggered, designated the 'reference trauma'. The PCL-C consists of 17 items, each designed to capture one of three distinct clusters of symptoms representing the B, C or D diagnostic criteria described for PTSD in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR), revised fourth edition [17]. These three clusters are labelled re-experiencing ('B' items, 1–5), avoidance or numbing ('C' items, 6–12) and hyper-arousal ('D' items, 13–17). The frequency of occurrence of each symptom for the past month is marked using a 1 (not at all) to 5 (extremely) likert-scale scoring. Scores are derived by summing the weighted frequencies for all items marked. Scores can range from 17–85. The PCL-C has been validated for use in samples of Veterans, with a total score of 60 or higher shown to be the most diagnostically useful cut score in indicating the presence of PTSD [18]. It is difficult to characterize the specific cause of psychological trauma in a large sample of individuals without using a structured clinical interview, as both the cause(s) of trauma (e.g. combat-exposure, sexual assault) and the individual's responses to traumatic experiences may vary. However, the current sample was limited to individuals deployed in a combat theatre of operations and who sustained a concussive injury during their deployment. Therefore, post-deployment stress, as measured by the PCL-C, will be referred to collectively as 'combat stress' in this study.

Post-concussive symptoms. The Neurobehavioural Symptom Inventory (NSI [5]) is a 22-item self-report inventory of common post-concussive sequelae. Subjects were instructed to rate the presence of each symptom within the past 2 weeks on a 5-item likert scale ranging from 0 (None) to 4 (Very Severe). A factor analysis of patients with mTBI revealed a four factor solution, consisting of an affective cluster, cognitive cluster, somatic cluster and sensory cluster [5]. In the current study, both individual items and cluster scores, as identified by Ciccerone's original study, were analysed.

Study design

Two groups were formed from the larger cohort of 472 service members with mTBIs on the basis of PCL-C scores. The High Combat Stress Group ($n = 108$) consisted of service members with PCL-C total scores ≥ 60. The PCL-C total score for the Low Combat Stress Group ($n = 132$) was ≤ 30. Subjects with PCL-C scores between 31–59 were excluded from analysis to maximize the dispersion of this variable ($n = 232$). Total sample size for final analysis was 240. Only four of 39 possible symptoms are directly overlapping on the PCL-C and NSI instruments: Trouble remembering, difficulty falling or staying asleep, irritability and poor concentration. Data were analysed using SPSS for Windows, Version 16 (SPSS, Inc., Chicago, IL, USA). The High Combat Stress and Low Combat Stress groups were compared on demographic variables including age, gender and rank, as well as number of deployments and time post-injury. Time post-injury was calculated as the difference between the date of evaluation (i.e. study consent and clinical interview to establish the diagnosis) and the date of injury in months. Subsequently, between-group differences were examined in post-concussive symptom report, controlling for significant differences on demographic characteristics. The statistical approach included both individual item analysis and symptom cluster analysis (affective, cognitive, somatic and sensory clusters) to explore the hypothesis that heightened combat stress would significantly elevate emotional and cognitive post-concussive symptoms.

Results

Descriptive analyses were performed and mean scores and standard deviations were obtained. Demographic information obtained in this study included age, gender and rank.

For the purpose of analysis, military rank was categorized into three levels, consistent with traditional military classification, enlisted (including E-1–E-4), non-commissioned officers (NCO; E-5–E-9) and officers (O-1–O-6). The following service branches of the United States Military were represented with 195 (81.2%) Army, 13 (5.4%) Marine Corps, five (2.1%) Air Force, one (0.4%) Navy and 26 (10.8%) Activated Army Reserve/ National Guard. All subjects sustained mTBI while deployed in support of Operation Iraqi Freedom (OIF; 235, 97.9%) and Operation Enduring Freedom (OEF; 5, 2.1%). There were significant differences between the High Stress and Low Stress Groups on gender, rank and time post-injury. See Table I for demographic and injury-related variables for High and Low Combat Stress groups.

Table I. Demographic and injury-related variables for high and low combat stress groups.

	Low stress ($n=132$)	High stress ($n=108$)
Age	26.4 (6.5)	27.8 (6.9)
Gender (% male)*	99.2%	94.4%
Rank*		
Enlisted	58%	54%
NCO	33%	44%
Officers	9%	2%
Months post-injury**	3.8 (5.8)	7.3 (11.0)
Blast mechanism of injury	84%	85%
% First deployment	66.7%	57.4%

Values for age and months post-injury are mean (SD); NCO, non-commissioned officers; *significant at the 0.05 level; **significant at the 0.01 level.

Regarding age, independent samples *t*-test revealed no significant between group differences ($t=-1.5$; $p=0.13$). Of the total sample ($n=242$), there were only seven females included in this study, six of whom were in the High Combat Stress group. Chi-square analysis was conducted which showed a statistically significant difference in gender proportion between groups ($\chi^2=4.8$; $p=0.03$). Rank significantly differed between groups ($\chi^2=7.4$; $p=0.03$), with a larger proportion of officers in the Low Stress group. In terms of injury-related variables, there was a significant difference on time post-injury ($t=-3.0$; $p=0.003$), with a longer injury-to-assessment interval in the High Stress group, but neither mechanism of injury ($\chi^2=0.06$; $p=0.82$) nor number of deployments ($\chi^2=2.2$; 0.14) were significantly different.

An analysis of covariance (ANCOVA), controlling for the effects of gender, rank and time post-injury, was performed between the Low Combat Stress and High Combat Stress groups.

NSI total scores were significantly higher for the high combat stress group ($\bar{x}=44.41$, SD $=22.83$) than the low combat stress group ($\bar{x}=12.33$, SD $=10.37$) ($F=190.70$, $p<0.001$). All NSI item and cluster scores were significantly higher for the high combat stress group than the low combat stress group (see Table II). NSI scores ranged from 3–8-times higher in the High Stress group compared to the Low Stress group.

The PCS symptoms which were identified as most problematic by the Low Stress group were sleep, headache and memory, with mean scores of ~1.0–1.25 out of 4, with a score of 1 on the scale indicating a 'mild' level of severity of the symptom.

Table II. Post-concussive symptom ratings.

NSI symptom	Low stress *M* (SD)	High stress *M* (SD)	*F*	*p**
Total score	12.33 (10.37)	44.41 (22.83)	190.70	0.000
Physical Cluster	3.59 (3.70)	13.83 (5.61)	271.01	0.000
Dizziness	0.52 (0.81)	1.88 (1.13)	117.12	0.000
Balance	0.45 (0.66)	1.89 (1.04)	161.88	0.000
Coordination	0.30 (0.55)	1.98 (1.04)	250.06	0.000
Nausea	0.31 (0.70)	1.57 (1.12)	113.08	0.000
Vision	0.51 (0.99)	1.68 (1.23)	55.18	0.000
Appetite Change	0.50 (0.84)	2.05 (1.10)	142.75	0.000
Cognitive Cluster	3.04 (3.40)	13.32 (3.90)	435.59	0.000
Concentration	0.47 (0.79)	2.87 (0.88)	458.05	0.000
Memory	0.95 (1.14)	3.00 (0.91)	216.64	0.000
Decision Making	0.33 (0.73)	2.28 (1.13)	244.25	0.000
Thinking/Org	0.42 (0.81)	2.57 (0.98)	309.52	0.000
Fatigue	0.86 (0.91)	2.60 (1.04)	171.92	0.000
Affective Cluster	2.97 (2.93)	14.64 (3.48)	768.88	0.000
Anxiety	0.48 (0.82)	2.96 (0.91)	477.45	0.000
Depression	0.30 (0.64)	2.44 (1.19)	288.32	0.000
Irritability	0.63 (0.89)	2.95 (0.90)	395.21	0.000
Frustration	0.31 (0.68)	2.82 (0.95)	550.18	0.000
Sensory Cluster	2.75 (2.57)	9.59 (4.13)	216.52	0.000
Sensitivity to Light	0.65 (0.99)	2.06 (1.44)	65.54	0.000
Sensitivity to Noise	0.48 (0.87)	2.50 (1.09)	243.17	0.000
Numbness	0.76 (0.96)	1.83 (1.26)	41.73	0.000
Headache	1.01 (1.15)	2.79 (1.18)	134.25	0.000
Sleep Problems	1.24 (1.17)	3.45 (0.70)	278.39	0.000
Hearing	0.70 (1.02)	2.06 (1.11)	86.15	0.000
Change Taste/Smell	0.15 (0.60)	1.14 (1.14)	62.13	0.000

*Significance based on ANCOVA, controlling for the effects of gender, rank and time post-injury.

Discussion

Service members who sustained concussive injuries and were experiencing high levels of co-occurring combat stress reported a 3–8-fold increase in post-concussive symptoms over concussed service members without a co-morbid stress disorder. Elevations on emotional and cognitive symptoms were expected in the High Stress group, as these symptoms are reflected in the diagnostic criteria for PTSD [17]. However, the elevations observed in this study were not limited to the emotional and/or cognitive domain, but rather were inclusive of all measured post-concussive symptoms. The elevations on symptoms traditionally viewed as specific to mTBI, such as headache [19] and balance and co-ordination difficulties [20] were contrary to the hypothesis of this study. Of note, service members in the Low Combat Stress group endorsed few post-concussive symptoms overall and the severity of those symptoms were on average rated as no more than a mild difficulty. The most frequently reported symptom was sleep disturbance, followed by headache and memory difficulties. In the absence of a non-concussed post-deployment control group, it is unclear if these symptoms are consistent with base rates in the overall post-deployment population or whether they represent more specific post-concussive sequelae.

There are several possible reasons for the findings of the current study. First, although the aetiology of the disorders is very different, post-traumatic stress disorder and post-concussion syndrome share clinical symptoms, thereby making it difficult to infer an aetiology in any situation where both a mTBI and psychological trauma may have occurred. Diagnosis of either condition is made through clinical interview and subjective report of the patient, often relying upon a historical account [15]. To date, there are no objective diagnostic tools, such as neuroimaging, biomarkers or blood tests that can reliably confirm or rule out a suspected diagnosis. Methodological flaws inherent in the post-deployment screening and assessment of mTBI and PTSD have been well articulated [21], casting suspicion on iatrogenic factors as a potential cause of many new mTBI diagnoses. However, in the absence of enhanced diagnostic specificity, it remains plausible that individuals diagnosed with one condition may meet criteria for the other condition as well, given the non-specific nature of the diagnostic criteria and over-reliance upon historical accounts of events. This possibility is supported by several studies that have shown that non-brain injured trauma controls frequently meet diagnostic criteria for post-concussion syndrome [12, 19] due to the poor specificity of post-concussive symptoms.

In their recent review of the functional neuroanatomy of PTSD and combat-related injuries, Taber and Hurley [22] discussed the possibility that mTBI may potentiate the onset of PTSD. They cite the studies of Hoge et al. [2] and Schneiderman [4] which both showed that the incidence of PTSD increases nearly 5-fold in individuals who sustained a mild TBI with loss of consciousness when compared with deployed service members who did not sustain TBIs. Increased frequency and severity of PTSD has also been shown in Vietnam-era veterans with a history of TBI [23]. Given this potential association, it remains plausible that the presence of combat stress may serve in a similar fashion as a catalyst for the development of post-concussion syndrome or at least the maintenance of post-concussive symptoms beyond the typical period of recovery. One of the limitations of the current study is the lack of a control group(s) of non-concussed service members with and without PTSD. Inclusion of such a group may have helped to better understand whether the relationship between PTSD and PCS is truly co-morbid or simply artificial. Additionally, other potentially confounding variables, such as pain, pre-injury psychiatric history and history of multiple concussions were not available for analysis in this study, but may have contributed to one's understanding of the relationship between these conditions.

Another possible explanation for the findings of the current study is that reporting bias could have influenced the results. Specifically, service members were instructed that they were filling out self-report questionnaires of neurologic and psychologic symptoms purportedly related to experiencing a TBI. Symptomatic patients may have simply endorsed all symptoms, creating the illusion that the variables are associated, when this association is actually spurious. Response bias is frequently addressed on self-report measures through the inclusion of false symptoms (e.g. double-vision), which are infrequently endorsed by control subjects and/or individuals with the disorder. This method has proven very helpful in detecting negative response bias, such as malingering in personal injury litigants [24] and somatization in primary care settings [25]. Pseudo-neurological or false symptoms were not administered to the service members in the current study.

One of the major limitations faced by clinicians and researchers examining mTBI in OEF/OEF service members and Veterans is the reliance upon self-report data. In the context of war injuries, battlefield trauma is primarily focused upon life-saving medical care and is heavily dependent upon triage. Consequently, non-life threatening injuries, such as concussions, are not typically documented into the medical record system in the immediate post-injury period. As a result, medical personnel cannot obtain corroborative interviews to validate injuries and are largely dependent upon retrospective assessment and self-report. These limitations are inherent in the military medical triage system and force reliance upon self-report data which impacts the reliability of the diagnosis. Similarly, combat-stress symptoms were assessed in the current study using a self-report measure, rather than structured clinical interviews. Support for the decision to use the PCL-Civilian version came from validation studies in Veteran samples, with convergent validity demonstrated through strong correlations ($r = 0.79$) between the PCL-C and structured clinical interviews of PTSD symptoms [18]. There is often a trade-off between the advantages of using a measure which has been psychometrically-validated and one which is more context-specific, such as the PCL–Military version. Given interest in examining traumatic experiences specific to combat, in retrospect, the PCL-M may have been a more optimal choice for this study.

Although questions remain about the aetiology of these disorders and their relationship to one another, the findings of the current study suggest that considerable caution should be exercised in making the diagnosis of PCS in patients with combat-stress disorders. Post-concussion syndrome is often

diagnosed in individuals solely on the basis of current symptom presentation without clear evidence that the symptoms are causally related to an historic injury event. The results of the present study suggest that other factors, such as high-levels of combat stress, may impact post-concussive symptom reporting in this population, further confounding the ability to make a correct diagnosis. The implications of this study are likely to be most relevant in medico-legal, disability and other compensatory contexts for which diagnostic specificity is required to avoid pyramiding, in which signs and symptoms are used to support multiple aetiologies. Replication and extension of this research using non-brain injured control subjects may help to further delineate this association.

Acknowledgements

A portion of this work was presented at the 2009 American Neuropsychiatric Association conference, San Antonio, Texas.

The opinions and assertions contained in this article are solely the authors' private ones and are not to be construed as official or reflecting the views of the United States Army or the Department of Defense. This manuscript was prepared by United States Government employees and therefore cannot be copyrighted and may be copied without restriction.

***Declaration of interest*:** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

References

1. Warden D. Military TBI during the Iraq and Afghanistan Wars. Journal of Head Trauma Rehabilitation 2006;21:398–402.
2. Hoge CW, McGurk D, Thomas JI, Cox AL, Engel CC, Castro CA. Mild traumatic brain injury in U.S. soldiers returning from Iraq. The New England Journal of Medicine 2008;358:453–463.
3. Defense and Veterans Brain Injury Center. Operation Iraqi Freedom (OIF)/Operation Enduring Freedom (OEF) Fact Sheet. November 2008.
4. Schneiderman AI, Braver ER, Kang HK. Understanding sequelae of injury mechanisms and mild traumatic brain injury incurred during the conflicts in Iraq and Afghanistan: Persistent postconcussive symptoms and posttraumatic stress disorder. American Journal of Epidemiology 2008;167: 1446–1452.
5. Ciccerone K, Kalmar K. Persistent postconcussion syndrome: The structure of subjective complaints after mild traumatic brain injury. Journal of Head Trauma Rehabilitation 1995;10: 1–17.
6. McCrea M. Mild Traumatic Brain Injury and Postconcussion Syndrome: The new evidence base for diagnosis and treatment. New York, NY: Oxford University Press; 2008.
7. Carroll LJ, Cassidy JD, Peloso PM, Borg J, von Holst H, Holm L, Paniak C, Pepin M. Prognosis of mild traumatic brain injury: Results of the WHO Collaborating Centre Task Force on Mild Traumatic Brain Injury. Journal of Rehabilitation Medicine 2004;43(suppl):84–105.
8. McCauley SR, Boake C, Pedroza C, Brown SA, Levin HS, Goodman HS, Merritt SG. Postconsussional disorder: Are the DSM–IV criteria an improvement over the ICD–10? The Journal of Nervous and Mental Disease 2005;193: 540–550.
9. Lange RT, Iverson GL, Franzen MD. Comparability of neuropsychological test profiles in patients with chronic substance abuse and mild traumatic brain injury. Clinical Neuropsychology 2008;22:209–227.
10. Trahan DE, Ross CE, Trahan SL. Relationships among postconcussional-type symptoms, depression, and anxiety in neurologically normal young adults and victims of mild traumatic brain injury. Archives of Clinical Neuropsychology 2001;16:435–445.
11. Sawchyn JM, Brulot MM, Strauss E. Note on the use of the postconcussion syndrome checklist. Archives of Clinical Neuropsychology 2000;15:1–8.
12. Meares S, Shores EA, Taylor AJ, Bathceor J, Bryant RA, Baguley IJ, Chapman J, Gurka J, Dawson K, Capon L, et al. Mild traumatic brain injury does not predict acute post-concussion syndrome. Journal of Neurology. Neurosurgery & Psychiatry 2008;79:300–306.
13. Fox DD, Lees-Haley PR, Earnest K, Dolezal-Wood S. Base rates of postconsussive symptoms in health maintenance organization patients and controls. Neuropsychology 1995;9: 606–611.
14. Powell GE. Mild traumatic brain injury and postconcussion syndrome: The importance of base rates in diagnosis and clinical formulation. Journal of Neurology, Neurosurgery & Psychiatry 2008;79:237.
15. American College of Rehabilitation Medicine. Definition of mild traumatic brain injury. Journal of Head Trauma Rehabilitation 1993;8:86–87.
16. Blanchard E, Jones-Alexander J, Buckley T, Forneris CA. Psychometric properties of the PTSD Checklist. Behavioral Research and Therapy 1996;34:669–673.
17. American Psychiatric Association. Diagnostic and statistical manual of mental disorder. 4th ed. Text Revision. Washington, DC, American Psychiatric Association; 2000.
18. Keen SM, Kutter Cj, Niles BL, Krinsley KE. Psychometric properties of PTSD checklist in sample of male veterans. Journal of Rehabilitation Research and Development 2008;45:465–474.
19. Boake C, McCauley SR, Levin HS, Pedroza C, Contant CF, Song JX, Brown SA, Goodman H, Brundage SI, Diaz-Marchan PJ. Diagnostic criteria for Postconcussional Syndrome after mild to moderate traumatic brain injury. Journal of Neuropsychiatry and Clinical Neurosciences 2005;17:350–356.
20. Hoffer ME, Balaban C, Gottshall K, Balough BJ, Maddox MR, Penta JR. Blast exposure: Vetibular consequences and associated characteristics. Otology & Neurotology 2010;31:232–236.
21. Hoge CW, Goldberg HM, Castro CA. Care of war veterans with mild traumatic brain injury – Flawed perspectives. The New England Journal of Medicine 2009;360: 1588–1591.

22. Taber KH, Hurley RA. PTSD and combat-related injuries: Functional neuroanatomy. Journal of Neuropsychiatry and Clinical Neurosciences 2009;21:1–4.
23. Chemtob CM, Muraoka MY, Wu-Holt P, Fairbank JA, Hamada RS, Keane TM. Head injury and combat-related posttraumatic stress disorder. Journal of Nervous and Mental Disorders 1998;186:701–708.
24. Lees-Haley PR, English LT, Glenn WJ. A Fake Bad Scale on the MMPI-2 for personal injury claimants. Psychological Reports 1991;68:203–210.
25. Interian A, Gara MA, Diaz-Martinez AM, Warman MJ, Escoba JI, Allen LA, Manetti-Cusa J. The Value of pseudoneurological symptoms for assessing psychopathology in primary care. Psychosomatic Medicine 2004;66:141–146.